ASE
Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning

STORMWATER MANAGEMENT REPORT

Self-Storage Facility
100 Milford Road
South Grafton, MA

February 4, 2015

Assessors Plat/Lot:
133/1B

Zoning District:
Office-Light Industrial

Applicant:
Hilltop Self-Storage of Grafton, LLC
100 Milford Road
South Grafton, MA 01560

Representative:
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STORMWATER MANAGEMENT REPORT

"Self-Storage Facility"
100 Milford Road
South Grafton, MA 01560

February 4, 2015

Prepared for:

Hilltop Self-Storage of Grafton, LLC
116 Milford Road
South Grafton, MA 01560

Prepared by:

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ASE Project #2014-316

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PART 1 – SUMMARY

PROJECT DESCRIPTION

Hilltop Self-Storage, intends to develop the property located at 100 Milford Road. Included, is the construction of 9 self-storage buildings with 1 building containing office space along with associated utilities, paving, and earthwork.

Located in an Office Light-Industrial Zone, the property is comprised of 5.0± acres of land situated on the south side of Milford Road across from Violet Lane and is bounded to the south by a solar farm and to the east and west by private single family residence. The property is currently an undeveloped field and there is a bordering vegetated wetland located on the west side of the property.

The property lies outside the 100-year flood plain according to the current Flood Insurance Rate Map (FIRM) Panel 25027C0842E (dated July 4, 2011), as shown in the Appendix.

The property currently has no utility services. The proposed site will have an on-site septic system and public water. Electric, telephone, ect. will be routed to the site via existing overhead utilities along Milford Road.

According to the 13th Edition of the Massachusetts Natural Heritage Atlas, Priority Habitat of Rare Species and Estimated Habitat of Rare Wetlands Wildlife is not located on or bordering the property. No known Areas of Critical Environmental Concern (ACEC) are located on or bordering the property.

The watershed under study is a total of 5.7± acres of which 4.0± acres comprise the subject parcel. The watershed under study includes a contributing areas outside the subject parcel from the east and south of the site. The mapped soils of the watershed consist of Montauk fine sandy loam and Scituate fine sandy loam which are generally associated with hydrologic soil group C. Under the pre-development scenario, the site has been calculated as two watershed, as shown on the plan entitled "WATERSHED MAP – EXISTING CONDITIONS", included within Part II – Pre & Post Construction Computations.

2.0 BACKGROUND DATA

Soils explorations have been performed on the property by this office. The U.S. Natural Resources Conservation Service (NRCS), formerly SCS Soil Survey Maps indicate that soils with hydrologic soil group classification C, are present on the site.

Soils are as follows:

Montauk fine sandy loam ----------	Hydrologic group "C"
Scituate fine sandy loam----------	Hydrologic group "C"

On site tested performed previously noted areas of course sand toward the east of the site. In order to better reflect the actual soil conditions, it was assumed that soils to the east of the existing break in the property (area of the proposed access drive) were hydrologic group B and all soils to the west were hydrologic group C.

3.0 STORMWATER MANAGEMENT CONCEPT

Since the project is proposing an industrial use, it shall conform to the Massachusetts Stormwater Standards. Although there will be an increase in the impervious surface, through the use of "Best Management Practices (BMPs)," the rate of runoff will be maintained. Runoff will be collected and treated for quality in conformance with the state requirements.

The stormwater management systems shall be designed using BMPs, as found in the most recent version of Massachusetts Department of Environmental Protection (DEP) "Non-Point Source Management Manual". The applicant shall submit a stormwater management plan implementing the highest practicable level of stormwater treatment. The development shall conform to the Stormwater Management Standards of the DEP.

4.0 COMPLIANCE WITH STORMWATER STANDARDS

4.1 Untreated Stormwater (Standard 1)

The project is designed so that new stormwater conveyances (outfalls/discharges) do not discharge untreated stormwater into, or cause erosion to, wetlands.

Standard #1 is met.

4.2 Post-Development Peak Rates (Standard 2)

Hydrologic calculations were performed to determine the rate of runoff for the 2, 10 and 100-year storm events under pre-development (present) conditions. This value was established as the future (post-development) maximum allowable rate. Unmitigated post-development rates were then computed in a similar manner. It is the intent of the stormwater management system to minimize impacts to drainage patterns of downstream property and wetlands while simultaneously providing water quality treatment to runoff prior to its release from the site or discharge to wetlands.

The U.S.D.A. Soil Conservation Service (SCS) Technical Release 55 (TR-55), 1986, was used as the procedure for estimating runoff. A SCS TR-20-based computer program, "HydroCAD," was used for estimating peak discharges. TR-55 is a generally accepted model for use on small sites that begins with a rainfall amount uniformly imposed on the watershed over a specified time

distribution. Mass rainfall is converted to mass runoff by using a runoff curve number (CN). CN is based on soils, ground cover, impervious areas, interception and surface storage. Runoff is then transformed into a hydrograph that depends on runoff travel time through segments of the watershed. Development in a watershed changes its response to precipitation. The most common effects are reduced infiltration and decreased travel time, which result in significantly higher peak rates of runoff. The volume of runoff is determined primarily by the amount of precipitation and by infiltration characteristics related to soil type, antecedent rainfall, and type of vegetative cover, impervious surfaces, and surface retention. Travel time is determined primarily by slope, flow length, depth of flow surfaces. Peak rates of discharge are based on the relationship of the above parameters as well as the total drainage area of the watershed, the location of the development in relation to the total drainage area, and the effect of any flood control works or other manmade storage. Peak rates of discharge are also influenced by the distribution of rainfall within a given storm event.

Runoff will be collected and conveyed by closed piping systems with proposed treatment devices where it will be treated. The piping system is designed to contain and withstand maximum storm flows and velocities. The devices will serve the purpose of settling out sediments in runoff prior to discharge.

Stormwater management computations for the project site were performed using SCS-based Hydrocad for existing and proposed conditions, curve numbers, time of concentration, and unit hydrograph computations. The following were considered as part of runoff calculations.

Since urban areas are seldom completely covered by impervious structure, soils and soil properties are an important factor in estimating the total volume of direct runoff. The infiltration and percolation rates of soils indicate their potential to absorb rainfall and thereby reduce the amount of direct runoff. Soils having a high infiltration rate (sands or gravels) have a low runoff potential, and soils having a low infiltration rate (clays) have a high runoff potential. Urbanization on soils with a high infiltration rate increases the volume of runoff and peak discharge more than urbanization on soils with a low infiltration rate.

The type of surface cover and its hydrologic condition affects runoff volume through its influence on the infiltration rate of the soil. Unused cultivated land yields more runoff than forested land for a given soil type. Covering areas with impervious material reduces surface storage and infiltration and increases the volume of runoff.

Some rainfall is retained on the ground surface and by vegetation before runoff begins. Interception is rainfall that is caught by foliage, twigs, branches, leaves,

etc. This rainfall is lost to evaporation and thus never reaches the ground surface. Increasing the vegetative cover increases the amount of interception.

Surface depression storage begins when precipitation exceeds infiltration. Overland flow starts when the surface depressions are full. The water in depression storage is not available as direct runoff.

Initial abstraction is the sum of interception, depression, storage, and infiltration before runoff begins. It occurs on all types of cover, from lawn in good condition to pavement. However, the amount of initial abstraction is less on pavement than on lawn.

Travel time (Tt) is the time it takes water to travel from one location to another in a watershed. Tt is a component of time of concentration (Tc) that is the time for runoff to travel from the hydraulically most distant point of the watershed to a point of interest within the watershed. Tc is computed by summing all the travel time for consecutive components of the drainage conveyance system.

Tc influences the shape and peak of the runoff hydrograph. Urbanization usually decreases Tc thereby increasing the peak discharge.
Development can change the effective slope of a watershed if flow paths are altered by channeling and by changing the surface grading for building lots, roads and ditches. The slopes of street gutters, roads and overland flow areas as well as stream channels are significant in determining travel times through urban watersheds.

Flow length may be reduced if natural meandering streams are changed to straight channels. It may be increased if overland flows are diverted through ditches, storm drains, or street gutters to larger collections systems.

Surface roughness is also a consideration. Flow velocity normally increases significantly when the flow path is changed from flow over rough surfaces of woodland, grassland and natural channels to sheet flow over smooth surfaces of parking lots, storm drains, gutters and lined channels.

4.2.1 Existing Conditions

Physical characteristics and land use are described in Section 1.0.

Soils information was taken from U.S.D.A. SCS Soil Survey Worcester County (See Appendix). The SCS (now NRCS), website soils mapping indicates the following:

- 300B – Mantauk fine sandy loam, 3 to 8 percent slopes (Hydrologic Soil Group Classification C)
- 315B – Scituate fine sandy loam, 3 to 8 percent slopes (Hydrologic Soil Group Classification C)

4.2.2 Proposed Conditions

The proposed development will include the construction 9 self-storage buildings with 1 building also containing the management office and associated utilities, earthwork and paving. The newly installed access drive will be accessed via a connection to Milford Road and is located at the center of the site. To accommodate stormwater runoff a number of Best Management Practices (BMP's) have been proposed, deep sump catch basins, a sediment forebay and infiltration basin.

Under the post-development scenario, the site has been divided into 3 drainage subcatchments, shown on the plan entitled "WATERSHED MAP – DEVELOPED CONDITIONS", included within Part II – Pre & Post Construction Computations. There is no increase in contributing watershed area due to the development and peak runoff rates and volumes are mitigated through the construction of a sediment forebay and infiltration basin.

SC-1 describes runoff associated with a portion of the proposed access drive, landscaped and existing pervious areas, and a proposed roof which discharges via a roof drain. The runoff drains to Milford Road.

SC-2 describes runoff associated with a majority of the proposed drive lanes, the parking area, 8 of the proposed buildings and associated sidewalk and landscaping. The runoff drains to a deep sump catch basin with hood and is treated in a sediment forebay before discharging to the detention basin.

SC-3 describes runoff associated proposed landscaped area and existing pervious area which flows overland to the wetland.

The development meets the MADEP Stormwater Management Standards and the Town of Uxbridge ordinance's and regulations through the employment of Best Management Practices that address groundwater recharge, water quality (first flush) retention, and suspended solids removal within sustainable BMP's. See Appendix for computed solids quantities / removal process trains.

Post-development peak rates were determined and routed through the basins with the resulting hydrographs added to the hydrographs for the undeveloped, undetained areas. Based upon these analyses, the peak rates of runoff for the 2, 10, and 100-year storm events are as follows:

Table 4.2.2.1 Stormwater Peak Rate Summary			
PEAK DISCHARGE RATE OF FLOW TO AP-1			
	2-YR	10-YR	100-YR
Pre-Development (cfs)	0.5	1.9	4.4
Post-Development (cfs	0.5	1.6	3.2
Pre vs Post-Development (cfs)	0.0	-0.4	-1.2
PEAK DISCHARGE RATE OF FLOW TO AP-2			
	2-YR	10-YR	100-YR
Pre-Development (cfs)	2.7	6.7	12.9
Post-Development (cfs	2.5	6.7	12.5
Pre vs Post-Development (cfs)	-0.2	0.0	-0.5

Standard #2 is met.

4.3 Recharge to Groundwater (Standard 3)

Although runoff volumes will not increase after construction; recharge shall be provided. Therefore, stormwater runoff volume to be recharged to groundwater should be determined using the existing site (pre-development) soil conditions and the annual recharge from the post-development site should approximate the annual recharge from the pre-development or existing site, based on soil types.

Hydrologic Soil Group	Volume to Recharge (x Total Impervious Area)
A	0.60 inches of runoff
B	0.35 inches of runoff
C	0.25 inches of runoff
D	0.10 inches of runoff

4.3.1 Soil Textures

Soils information obtained from U.S.D.A. NRCS Soil Survey Report for Worcester Counties (see Appendix) determined that the stormwater runoff volume to be recharged is based on the Hydrologic Soil Classification Group B and C.

The hydrologic design methods presented in this appendix are based on the utilization of two hydrologic soil properties, the effective water capacity (Cw) and the minimum infiltration rate (f) of the specific soil textural groups, as shown in Table 4.3.1. The effective water capacity of a soil is the fraction of the void spaces available for water storage, measured in inches per inch. The minimum infiltration rate is the final rate that water passes through the soil profile during saturated conditions, measured in terms of inches per hour. The hydrologic soil properties are obtained by identifying the soil textures by a gradation test for each change in soil profile. The soil textures presented in

Table 4.3.1 correspond to the soil textures of the U.S. Department of Agriculture (USDA) Textural Triangle.

The data presented in Table 4.3.1 are based on the analysis of over 5,000 soil samples by the USDA under carefully controlled procedures. The use of the soil properties established in Table 4.3.1 for design and review procedures offers two advantages. First, it provides for consistency of results in the design procedures. Second, it eliminates the need for the laborious and costly process of conducting field and laboratory infiltration and permeability tests.

Table 4.3.1 – Hydrologic Soil Properties Classified by Soil Texture*

Texture Class	Effective Water Capacity (C_w) (inch per inch)	Minimum Infiltration Rate (f) (inch per hour)	NRCS Hydrologic Soil Group
Sand	0.35	8.27	A
Loamy Sand	0.31	2.41	A
Sandy Loam	0.25	1.02	B
Loam	0.19	0.52	B
Silt Loam	0.17	0.27	C
Sandy Clay Loam	0.14	0.17	C
Clay Loam	0.14	0.09	D
Silty Clay Loam	0.11	0.06	D
Sandy Clay	0.09	0.05	D
Silty Clay	0.09	0.04	D
Clay	0.08	0.02	D

* Source: Rawls, Brakensiek, & Saxton, 1982

Based on the soil textural classes and the corresponding minimum infiltration rates, a restriction is established to eliminate unsuitable soil conditions. Soil textures with minimum infiltration rates less than 0.52 inches per hour are not suitable for usage of infiltration practices. These include soils that have a 30 percent clay content, making these soils susceptible to frost heaving and structurally unstable, in addition to having a poor capacity to percolate runoff. Soil textures that are recommended for infiltration systems include those soils with infiltration rates of 0.52 inches per hour or greater, which include loam, sandy loam, and sand.

Required Recharge Volume

0..60 inches runoff x total impervious area = Recharge Volume, "A" soil
0.35 inches runoff x total impervious area = Recharge Volume, "B" soil
0.25 inches runoff x total impervious area = Recharge Volume, "C" soil
0.10 inches runoff x total impervious area = Recharge Volume, "D" soil

0.35 inches x (1ft. /12in.) x (33,841) sq. ft. = 987 cubic feet.*
0.25 inches x (1ft. /12in.) x (33,311) sq. ft. = 694 cubic feet.

Total Volume Required for Recharge = 1,681 cubic feet

*Previous on-site soil testing showed areas of B soil within the watershed area

Recharge Volume Provided

- Infiltration Basin 1 = 10,686 cu. ft

Total recharge volume provided = 10,686 cu. ft.

Comparison of Required Recharge Volume to Provided Recharge
Provided Recharge - Required Recharge = Additional Recharge
10,686 cu. ft. – 1,681 cu. ft. = 9,005 cu. ft.

Drawdown Time

Basin Storage Volume / ((Infiltration Rate / 12) x (Basin Bottom Area)

10,686 / ((1.02 /12) x (4,685)) = 26.8 hours

Per the Massachusetts Stormwater Standards a mounding analysis is required when the vertical separation from the bottom of an exfiltration system to seasonal high groundwater is less than four (4) feet and the recharge system is proposed to attenuate the peak discharge from a 10-year or higher 24-hour storm.

Mounding analysis calculated using the Hantush (1967) method. Automated calculator available online from the Aquifer Test Forum sponsored by HydroSOLVE, Inc. The calculated mounds will not interfere with the draining of the infiltration basins, the results are as follows:

	Infiltration Area	No.1
Hydraulic Conductivity	ft/day	8
		Standard value for "Loamy Sand" material
Specific Yield		0.23
		Standard value for "Loamy Sand" material
Initial Saturated Thickness	ft	20
		Depth to bedrock
Design Recharge Rate	ft/day	2.04
		infiltration rate
Time	days	3
		Minimum 72 hr evaluation period
Bottom Infiltrating Area	sf	4,685
Length of Infiltration Area	ft	200.3
Width of Infiltration Area	ft	24.53
Time when Infiltration Stops	days	1.12
		Calculated Drawdown Time (see Above)
Maximum Water table rise at 72 hours[1]	ft	**1.49**
	in	18

Standard #3 is met.

4.4 Removal of 80% TSS (Standard 4)

The proposed stormwater management system design calls for 4' deep sump catch basins to collect runoff from the roadway. Stormwater runoff from pavement areas will then be conveyed by a closed pipe system through either a proprietary stormwater treatment unit (Hydroguard Unit) which discharges to a level spreader or to sediment forebay followed by an infiltration basin. Calculations for removal rates for all paved runoff are below. These calculation are shown on the attached TSS Calculation Worksheet in Table 5.4.

Street Sweeping	10%
Deep Sump Catch Basins	25%
Infiltration Basin w/ sediment forebay	80%

Water Quality

Vwq = (Dwq ÷ 12inches/foot) (Aimp)

Where:
Vwq = Required Water Quality Volume (cubic feet)
Dwq = Water Quality Depth – 1 inch
Aimp = Impervious Area (s.f.)

Vwq Required
Driveway Basin = (0.5 ÷ 12inches/foot) x 67,152 s.f. = 2,798c.f.

Water Quality Volume Provided

Outlets in the infiltration basins are set at an elevation above the required water quality volume. The volume provided exceeds the requirement and is as follows:

Infiltration Basin = 10,686 c.f.

Forebay Sizing

The forebay volume is based on 0.1-inch over the contributing impervious area.

Volume Required
Forebay volume = 946 cu .ft.

Volume Provided
Forebay volume = 1,235 cu .ft.

Standard #4 is met.

4.5 Land Uses with Higher Potential (Standard 5)

This project does not contain areas with higher potential for pollution.

Standard #5 is met.

4.6 Critical Areas (Standard 6 – Water Quality Treatments)

This site does not lie within a critical area.

Standard #6 is not applicable.

4.7 Redevelopment (Standard 7)

Redevelopment projects are those that involve development, rehabilitation or expansion on previously developed sites provided the redevelopment results in no net increase in impervious area. Furthermore, components of redevelopment project, which include development of previously undeveloped sites, do not fall under Standard 7. In addition, redevelopment of previously developed sites must meet the Stormwater Management Standards to the maximum extent practicable. However, if it is not practicable to meet all the Standards, new (retrofitted or expanded) stormwater management systems must be designed to improve existing conditions.

This is not a redevelopment project.

Standard #7 is not applicable.

4.8 Erosion and Sedimentation Controls (Standard 8)

Erosion and Sedimentation Control details are provided as part of the site plan application to the Planning Board.

Standard #8 is met.

4.9 Operation and Maintenance Plan (Standard 9)

An Operation and Maintenance Plan is provided (separate document).

Standard #9 is met.

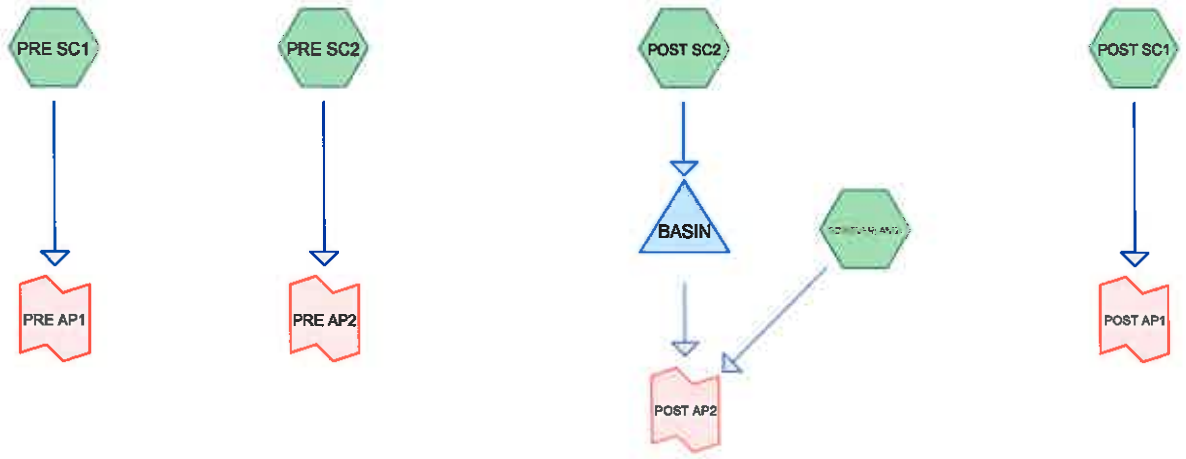
4.10 Illicit Discharges (Standard 10)

An Illicit Discharge Statement is included herewith. See Appendix

A pollution prevention plan is incorporated into this report to prevent illicit discharges during and after construction.

Standard #10 is met.

PART II – PRE & POST-CONSTRUCTION COMPUTATIONS & MAPS



Subcat Reach Pond Link

Routing Diagram for 2014-316_Stormwater
Prepared by {enter your company name here}, Printed 2/4/2015
HydroCAD® 10.00-13 s/n 02271 © 2014 HydroCAD Software Solutions LLC

Summary for Subcatchment POST SC1:

Runoff = 0.52 cfs @ 12.18 hrs, Volume= 2,479 cf, Depth= 0.60"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
43,460	61	>75% Grass cover, Good, HSG B
661	74	>75% Grass cover, Good, HSG C
739	98	Paved parking, HSG B
498	98	Paved parking, HSG C
4,200	98	Roofs, HSG B
49,558	65	Weighted Average
44,121		89.03% Pervious Area
5,437		10.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0400	0.13		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
1.2	231	0.0430	3.34		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
2.7	507	0.0075	3.10	12.41	**Channel Flow, Segment C** Area= 4.0 sf Perim= 6.5' r= 0.62' n= 0.030
0.3	90	0.0730	4.35		**Shallow Concentrated Flow, Segment D** Unpaved Kv= 16.1 fps
10.4	878	Total			

Summary for Subcatchment POST SC2:

Runoff = 8.60 cfs @ 12.09 hrs, Volume= 28,443 cf, Depth= 2.54"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
33,841	98	Paved parking, HSG B
33,311	98	Paved parking, HSG C
21,850	98	Roofs, HSG B
24,500	98	Roofs, HSG C
6,580	61	>75% Grass cover, Good, HSG B
14,093	74	>75% Grass cover, Good, HSG C
134,175	94	Weighted Average
20,673		15.41% Pervious Area
113,502		84.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Segment A**

Summary for Subcatchment PRE SC1:

Runoff = 0.51 cfs @ 12.17 hrs, Volume= 2,791 cf, Depth= 0.44"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
75,430	61	>75% Grass cover, Good, HSG B
75,430		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0500	0.15		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
2.9	560	0.0400	3.22		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
8.6	610	Total			

Summary for Subcatchment PRE SC2:

Runoff = 2.70 cfs @ 12.17 hrs, Volume= 11,286 cf, Depth= 0.78"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
69,734	61	>75% Grass cover, Good, HSG B
103,983	74	>75% Grass cover, Good, HSG C
173,717	69	Weighted Average
173,717		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0400	0.13		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
2.2	425	0.0400	3.22		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
2.2	300	0.0200	2.28		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
10.6	775	Total			

Summary for Subcatchment SC3(OVERLAND):

Runoff = 1.19 cfs @ 12.16 hrs, Volume= 4,786 cf, Depth= 0.88"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 2-Year Rainfall=3.20"

Area (sf)	CN	Description
26,566	61	>75% Grass cover, Good, HSG B
30,772	74	>75% Grass cover, Good, HSG C
7,922	96	Gravel surface, HSG B
144	96	Gravel surface, HSG C
65,404	71	Weighted Average
65,404		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0280	0.12		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
1.6	352	0.0510	3.64		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
1.7	247	0.0240	2.49		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
10.5	649	Total			

Summary for Pond BASIN:

Inflow Area = 134,175 sf, 84.59% Impervious, Inflow Depth = 2.54" for 2-Year event
Inflow = 8.60 cfs @ 12.09 hrs, Volume= 28,443 cf
Outflow = 1.90 cfs @ 12.50 hrs, Volume= 28,445 cf, Atten= 78%, Lag= 24.7 min
Discarded = 0.18 cfs @ 12.50 hrs, Volume= 12,891 cf
Primary = 1.72 cfs @ 12.50 hrs, Volume= 15,553 cf

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 464.03' @ 12.50 hrs Surf.Area= 7,588 sf Storage= 12,412 cf

Plug-Flow detention time= 204.0 min calculated for 28,425 cf (100% of inflow)
Center-of-Mass det. time= 204.3 min (991.4 - 787.1)

Volume	Invert	Avail.Storage	Storage Description
#1	462.00'	30,279 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
462.00	4,685	454.0	0	0	4,685
463.00	6,079	474.0	5,367	5,367	6,233
464.00	7,540	496.0	6,796	12,163	7,999
465.00	9,055	514.0	8,286	20,449	9,532
466.00	10,626	533.0	9,830	30,279	11,199

Device	Routing	Invert	Outlet Devices
#1	Primary	462.00'	**12.0" Round Culvert** L= 38.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 462.00' / 461.24' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	462.80'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	463.90'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Discarded	462.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#5	Primary	465.05'	**10.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Discarded OutFlow Max=0.18 cfs @ 12.50 hrs HW=464.03' (Free Discharge)
└**4=Exfiltration** (Controls 0.18 cfs)

Primary OutFlow Max=1.72 cfs @ 12.50 hrs HW=464.03' TW=0.00' (Dynamic Tailwater)
├**1=Culvert** (Passes 1.72 cfs of 3.70 cfs potential flow)
│ ├**2=Orifice/Grate** (Orifice Controls 1.59 cfs @ 4.57 fps)
│ └**3=Orifice/Grate** (Orifice Controls 0.12 cfs @ 1.24 fps)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link POST AP1:

Inflow Area = 49,558 sf, 10.97% Impervious, Inflow Depth = 0.60" for 2-Year event
Inflow = 0.52 cfs @ 12.18 hrs, Volume= 2,479 cf
Primary = 0.52 cfs @ 12.18 hrs, Volume= 2,479 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Link POST AP2:

Inflow Area = 199,579 sf, 56.87% Impervious, Inflow Depth = 1.22" for 2-Year event
Inflow = 2.53 cfs @ 12.20 hrs, Volume= 20,339 cf
Primary = 2.53 cfs @ 12.20 hrs, Volume= 20,339 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Link PRE AP1:

Inflow Area = 75,430 sf, 0.00% Impervious, Inflow Depth = 0.44" for 2-Year event
Inflow = 0.51 cfs @ 12.17 hrs, Volume= 2,791 cf
Primary = 0.51 cfs @ 12.17 hrs, Volume= 2,791 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Link PRE AP2:

Inflow Area = 173,717 sf, 0.00% Impervious, Inflow Depth = 0.78" for 2-Year event
Inflow = 2.70 cfs @ 12.17 hrs, Volume= 11,286 cf
Primary = 2.70 cfs @ 12.17 hrs, Volume= 11,286 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Subcatchment POST SC1:

Runoff = 1.55 cfs @ 12.16 hrs, Volume= 6,018 cf, Depth= 1.46"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
43,460	61	>75% Grass cover, Good, HSG B
661	74	>75% Grass cover, Good, HSG C
739	98	Paved parking, HSG B
498	98	Paved parking, HSG C
4,200	98	Roofs, HSG B
49,558	65	Weighted Average
44,121		89.03% Pervious Area
5,437		10.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0400	0.13		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
1.2	231	0.0430	3.34		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
2.7	507	0.0075	3.10	12.41	**Channel Flow, Segment C** Area= 4.0 sf Perim= 6.5' r= 0.62' n= 0.030
0.3	90	0.0730	4.35		**Shallow Concentrated Flow, Segment D** Unpaved Kv= 16.1 fps
10.4	878	Total			

Summary for Subcatchment POST SC2:

Runoff = 13.21 cfs @ 12.09 hrs, Volume= 44,862 cf, Depth= 4.01"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
33,841	98	Paved parking, HSG B
33,311	98	Paved parking, HSG C
21,850	98	Roofs, HSG B
24,500	98	Roofs, HSG C
6,580	61	>75% Grass cover, Good, HSG B
14,093	74	>75% Grass cover, Good, HSG C
134,175	94	Weighted Average
20,673		15.41% Pervious Area
113,502		84.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Segment A**

Summary for Subcatchment PRE SC1:

Runoff = 1.92 cfs @ 12.14 hrs, Volume= 7,497 cf, Depth= 1.19"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
75,430	61	>75% Grass cover, Good, HSG B
75,430		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0500	0.15		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
2.9	560	0.0400	3.22		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
8.6	610	Total			

Summary for Subcatchment PRE SC2:

Runoff = 6.70 cfs @ 12.16 hrs, Volume= 25,222 cf, Depth= 1.74"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
69,734	61	>75% Grass cover, Good, HSG B
103,983	74	>75% Grass cover, Good, HSG C
173,717	69	Weighted Average
173,717		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0400	0.13		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
2.2	425	0.0400	3.22		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
2.2	300	0.0200	2.28		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
10.6	775	Total			

Summary for Subcatchment SC3(OVERLAND):

Runoff = 2.78 cfs @ 12.16 hrs, Volume= 10,315 cf, Depth= 1.89"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 10-Year Rainfall=4.70"

Area (sf)	CN	Description
26,566	61	>75% Grass cover, Good, HSG B
30,772	74	>75% Grass cover, Good, HSG C
7,922	96	Gravel surface, HSG B
144	96	Gravel surface, HSG C
65,404	71	Weighted Average
65,404		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0280	0.12		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
1.6	352	0.0510	3.64		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
1.7	247	0.0240	2.49		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
10.5	649	Total			

Summary for Pond BASIN:

Inflow Area = 134,175 sf, 84.59% Impervious, Inflow Depth = 4.01" for 10-Year event
Inflow = 13.21 cfs @ 12.09 hrs, Volume= 44,862 cf
Outflow = 4.51 cfs @ 12.37 hrs, Volume= 44,864 cf, Atten= 66%, Lag= 16.8 min
Discarded = 0.20 cfs @ 12.37 hrs, Volume= 14,458 cf
Primary = 4.31 cfs @ 12.37 hrs, Volume= 30,406 cf

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 464.67' @ 12.37 hrs Surf.Area= 8,542 sf Storage= 17,559 cf

Plug-Flow detention time= 162.4 min calculated for 44,833 cf (100% of inflow)
Center-of-Mass det. time= 162.7 min (938.0 - 775.3)

Volume	Invert	Avail.Storage	Storage Description
#1	462.00'	30,279 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
462.00	4,685	454.0	0	0	4,685
463.00	6,079	474.0	5,367	5,367	6,233
464.00	7,540	496.0	6,796	12,163	7,999
465.00	9,055	514.0	8,286	20,449	9,532
466.00	10,626	533.0	9,830	30,279	11,199

Device	Routing	Invert	Outlet Devices
#1	Primary	462.00'	**12.0" Round Culvert** L= 38.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 462.00' / 461.24' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	462.80'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	463.90'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Discarded	462.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#5	Primary	465.05'	**10.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Discarded OutFlow Max=0.20 cfs @ 12.37 hrs HW=464.67' (Free Discharge)
└**4=Exfiltration** (Controls 0.20 cfs)

Primary OutFlow Max=4.30 cfs @ 12.37 hrs HW=464.67' TW=0.00' (Dynamic Tailwater)
├**1=Culvert** (Passes 4.30 cfs of 4.40 cfs potential flow)
│ ├**2=Orifice/Grate** (Orifice Controls 2.08 cfs @ 5.97 fps)
│ └**3=Orifice/Grate** (Orifice Controls 2.22 cfs @ 3.18 fps)
└**5=Broad-Crested Rectangular Weir** (Controls 0.00 cfs)

Summary for Link POST AP1:

Inflow Area = 49,558 sf, 10.97% Impervious, Inflow Depth = 1.46" for 10-Year event
Inflow = 1.55 cfs @ 12.16 hrs, Volume= 6,018 cf
Primary = 1.55 cfs @ 12.16 hrs, Volume= 6,018 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Link POST AP2:

Inflow Area = 199,579 sf, 56.87% Impervious, Inflow Depth = 2.45" for 10-Year event
Inflow = 6.55 cfs @ 12.20 hrs, Volume= 40,721 cf
Primary = 6.55 cfs @ 12.20 hrs, Volume= 40,721 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Link PRE AP1:

Inflow Area = 75,430 sf, 0.00% Impervious, Inflow Depth = 1.19" for 10-Year event
Inflow = 1.92 cfs @ 12.14 hrs, Volume= 7,497 cf
Primary = 1.92 cfs @ 12.14 hrs, Volume= 7,497 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Link PRE AP2:

Inflow Area = 173,717 sf, 0.00% Impervious, Inflow Depth = 1.74" for 10-Year event
Inflow = 6.70 cfs @ 12.16 hrs, Volume= 25,222 cf
Primary = 6.70 cfs @ 12.16 hrs, Volume= 25,222 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Subcatchment POST SC1:

Runoff = 3.23 cfs @ 12.15 hrs, Volume= 11,863 cf, Depth= 2.87"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
43,460	61	>75% Grass cover, Good, HSG B
661	74	>75% Grass cover, Good, HSG C
739	98	Paved parking, HSG B
498	98	Paved parking, HSG C
4,200	98	Roofs, HSG B
49,558	65	Weighted Average
44,121		89.03% Pervious Area
5,437		10.97% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0400	0.13		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
1.2	231	0.0430	3.34		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
2.7	507	0.0075	3.10	12.41	**Channel Flow, Segment C** Area= 4.0 sf Perim= 6.5' r= 0.62' n= 0.030
0.3	90	0.0730	4.35		**Shallow Concentrated Flow, Segment D** Unpaved Kv= 16.1 fps
10.4	878	Total			

Summary for Subcatchment POST SC2:

Runoff = 19.28 cfs @ 12.09 hrs, Volume= 66,982 cf, Depth= 5.99"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
33,841	98	Paved parking, HSG B
33,311	98	Paved parking, HSG C
21,850	98	Roofs, HSG B
24,500	98	Roofs, HSG C
6,580	61	>75% Grass cover, Good, HSG B
14,093	74	>75% Grass cover, Good, HSG C
134,175	94	Weighted Average
20,673		15.41% Pervious Area
113,502		84.59% Impervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.0					**Direct Entry, Segment A**

Summary for Subcatchment PRE SC1:

Runoff = 4.38 cfs @ 12.13 hrs, Volume= 15,637 cf, Depth= 2.49"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
75,430	61	>75% Grass cover, Good, HSG B
75,430		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
5.7	50	0.0500	0.15		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
2.9	560	0.0400	3.22		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
8.6	610	Total			

Summary for Subcatchment PRE SC2:

Runoff = 12.94 cfs @ 12.15 hrs, Volume= 47,331 cf, Depth= 3.27"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
69,734	61	>75% Grass cover, Good, HSG B
103,983	74	>75% Grass cover, Good, HSG C
173,717	69	Weighted Average
173,717		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
6.2	50	0.0400	0.13		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
2.2	425	0.0400	3.22		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
2.2	300	0.0200	2.28		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
10.6	775	Total			

Summary for Subcatchment SC3(OVERLAND):

Runoff = 5.20 cfs @ 12.15 hrs, Volume= 18,925 cf, Depth= 3.47"

Runoff by SCS TR-20 method, UH=SCS, Weighted-CN, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Type III 24-hr 100-Year Rainfall=6.70"

Area (sf)	CN	Description
26,566	61	>75% Grass cover, Good, HSG B
30,772	74	>75% Grass cover, Good, HSG C
7,922	96	Gravel surface, HSG B
144	96	Gravel surface, HSG C
65,404	71	Weighted Average
65,404		100.00% Pervious Area

Tc (min)	Length (feet)	Slope (ft/ft)	Velocity (ft/sec)	Capacity (cfs)	Description
7.2	50	0.0280	0.12		**Sheet Flow, Segment A** Grass: Dense n= 0.240 P2= 3.20"
1.6	352	0.0510	3.64		**Shallow Concentrated Flow, Segment B** Unpaved Kv= 16.1 fps
1.7	247	0.0240	2.49		**Shallow Concentrated Flow, Segment C** Unpaved Kv= 16.1 fps
10.5	649	Total			

Summary for Pond BASIN:

Inflow Area = 134,175 sf, 84.59% Impervious, Inflow Depth = 5.99" for 100-Year event
Inflow = 19.28 cfs @ 12.09 hrs, Volume= 66,982 cf
Outflow = 8.66 cfs @ 12.27 hrs, Volume= 66,989 cf, Atten= 55%, Lag= 11.1 min
Discarded = 0.23 cfs @ 12.27 hrs, Volume= 15,817 cf
Primary = 8.44 cfs @ 12.27 hrs, Volume= 51,172 cf

Routing by Dyn-Stor-Ind method, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs
Peak Elev= 465.31' @ 12.27 hrs Surf.Area= 9,529 sf Storage= 23,334 cf

Plug-Flow detention time= 133.6 min calculated for 66,942 cf (100% of inflow)
Center-of-Mass det. time= 134.1 min (899.8 - 765.7)

Volume	Invert	Avail.Storage	Storage Description
#1	462.00'	30,279 cf	**Custom Stage Data (Irregular)** Listed below (Recalc)

Elevation (feet)	Surf.Area (sq-ft)	Perim. (feet)	Inc.Store (cubic-feet)	Cum.Store (cubic-feet)	Wet.Area (sq-ft)
462.00	4,685	454.0	0	0	4,685
463.00	6,079	474.0	5,367	5,367	6,233
464.00	7,540	496.0	6,796	12,163	7,999
465.00	9,055	514.0	8,286	20,449	9,532
466.00	10,626	533.0	9,830	30,279	11,199

Device	Routing	Invert	Outlet Devices
#1	Primary	462.00'	**12.0" Round Culvert** L= 38.0' CPP, projecting, no headwall, Ke= 0.900 Inlet / Outlet Invert= 462.00' / 461.24' S= 0.0200 '/' Cc= 0.900 n= 0.013 Corrugated PE, smooth interior, Flow Area= 0.79 sf
#2	Device 1	462.80'	**8.0" Vert. Orifice/Grate** C= 0.600
#3	Device 1	463.90'	**8.0" Vert. Orifice/Grate X 2.00** C= 0.600
#4	Discarded	462.00'	**1.020 in/hr Exfiltration over Surface area** Conductivity to Groundwater Elevation = 0.00'
#5	Primary	465.05'	**10.0' long x 12.0' breadth Broad-Crested Rectangular Weir** Head (feet) 0.20 0.40 0.60 0.80 1.00 1.20 1.40 1.60 Coef. (English) 2.57 2.62 2.70 2.67 2.66 2.67 2.66 2.64

Discarded OutFlow Max=0.23 cfs @ 12.27 hrs HW=465.31' (Free Discharge)
└**4=Exfiltration** (Controls 0.23 cfs)

Primary OutFlow Max=8.35 cfs @ 12.27 hrs HW=465.31' TW=0.00' (Dynamic Tailwater)
├**1=Culvert** (Inlet Controls 5.00 cfs @ 6.37 fps)
│ ├**2=Orifice/Grate** (Passes < 2.48 cfs potential flow)
│ └**3=Orifice/Grate** (Passes < 3.48 cfs potential flow)
└**5=Broad-Crested Rectangular Weir** (Weir Controls 3.35 cfs @ 1.31 fps)

Summary for Link POST AP1:

Inflow Area = 49,558 sf, 10.97% Impervious, Inflow Depth = 2.87" for 100-Year event
Inflow = 3.23 cfs @ 12.15 hrs, Volume= 11,863 cf
Primary = 3.23 cfs @ 12.15 hrs, Volume= 11,863 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Link POST AP2:

Inflow Area = 199,579 sf, 56.87% Impervious, Inflow Depth = 4.21" for 100-Year event
Inflow = 12.58 cfs @ 12.22 hrs, Volume= 70,097 cf
Primary = 12.58 cfs @ 12.22 hrs, Volume= 70,097 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Link PRE AP1:

Inflow Area = 75,430 sf, 0.00% Impervious, Inflow Depth = 2.49" for 100-Year event
Inflow = 4.38 cfs @ 12.13 hrs, Volume= 15,637 cf
Primary = 4.38 cfs @ 12.13 hrs, Volume= 15,637 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

Summary for Link PRE AP2:

Inflow Area = 173,717 sf, 0.00% Impervious, Inflow Depth = 3.27" for 100-Year event
Inflow = 12.94 cfs @ 12.15 hrs, Volume= 47,331 cf
Primary = 12.94 cfs @ 12.15 hrs, Volume= 47,331 cf, Atten= 0%, Lag= 0.0 min

Primary outflow = Inflow, Time Span= 1.00-72.00 hrs, dt= 0.05 hrs

PART III – DRAIN PIPE & RIP RAP SIZING CALCULATIONS

"Hilltop Self Storage"
South Grafton, MA

From	To	Area (AC.) Incremental	Weighted Runoff Coefficient "C"	CxA	Cumulative CxA	Pipe Length (Feet)	Flow Time (min) To Inlet	Flow Time (min) In Channel	Design Storm (Year)	Intensity (IN/HR)	Q (CFS)	Size (IN)	Slope (FT/FT)	Mannings n	Full Capacity (cfs)	Full Velocity (fps)	Upper End Rim	Upper End Invert	Lower End Rim	Lower End Invert
CB1	DMH1	0.29	0.90	0.26	0.26	122.20	5.0	0.33	25	6.60	1.74	12	0.0190	0.013	4.91	6.25				
CB2	DMH1	0.25	0.90	0.23	0.23	5.00	5.0	0.01	25	6.60	1.51	12	0.0200	0.013	5.04	6.42	466.57	463.57	466.90	463.47
DMH1	FES1	--	--	--	0.49	52.30	5.0	0.21	25	6.60	3.25	12	0.0084	0.013	3.27	4.16	466.90	463.37		462.93
DCB3	DMH2	0.65	0.85	0.55	0.55	99.20	5.0	0.35	25	6.60	3.65	12	0.0110	0.013	3.73	4.76	468.64	465.64	468.90	464.54
CB4	DMH2	0.26	0.90	0.23	0.23	5.00	5.0	0.01	25	6.60	1.53	12	0.0200	0.013	5.04	6.42	468.71	465.71	468.90	465.61
DMH2	DMH3	--	--	--	0.79	100.40	5.0	0.38	25	6.60	5.18	15	0.0071	0.013	5.43	4.43	468.90	464.45	467.25	463.74
DCB5	DMH4	0.40	0.90	0.36	0.36	5.00	5.0	0.02	25	6.60	2.36	12	0.0060	0.013	2.76	3.51	467.85	464.85	468.10	464.82
CB6	DMH4	0.27	0.79	0.21	0.21	184.00	5.0	1.01	25	6.60	1.41	12	0.0050	0.013	2.52	3.21	468.79	465.79	468.10	464.82
DMH4	DMH3	--	--	--	0.57	180.00	5.0	0.77	25	6.60	3.76	15	0.0054	0.013	4.77	3.88	468.10	464.72	467.25	463.74
DMH3	FES2	--	--	--	1.36	50.00	5.0	0.16	25	6.60	8.94	18	0.0078	0.013	9.28	5.25	467.25	463.49		463.10
CB8	DMH5	0.02	0.90	0.02	0.02	10.00	5.0	0.02	25	6.60	0.14	12	0.0300	0.013	6.17	7.86	465.80	462.80	466.20	462.50
CB9	DMH5	0.26	0.90	0.23	0.23	58.00	5.0	0.30	25	6.60	1.53	12	0.0052	0.013	2.56	3.26	465.80	462.80	466.20	462.50
DMH5	FES4	--	--	--	0.25	39.00	5.0	0.20	25	6.60	1.67	12	0.0051	0.013	2.55	3.25	466.20	462.40		462.20
DCB7	FES3	0.52	0.90	0.47	0.47	17.00	5.0	0.04	25	6.60	3.10	12	0.0200	0.013	5.04	6.42	466.50	463.50		463.16

Pipe Calculations

100 Milford Road South Grafton, MA
Job# 2014-316

RIP RAP SIZING

FES1

Do=	1	ft
Q=	3.25	cfs (25-yr Storm)
Tw=	0.5	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	13.53	ft

W=3Do+La

W=	16.53	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.19	ft
	2.31	in

FES2

Do=	1.5	ft
Q=	8.94	cfs (25-yr Storm)
Tw=	0.75	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	20.27	ft

W=3Do+La

W=	24.77	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.29	ft
	3.46	in

FES3

Do=	1	ft
Q=	3.1	cfs (25-yr Storm)
Tw=	0.5	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	13.27	ft

W=3Do+La

W=	16.27	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.18	ft
	2.17	in

FES4

Do=	1	ft
Q=	0.41	cfs (25-yr Storm)
Tw=	0.5	ft

$La=1.7Q/(Do^{3/2})+8Do$

La=	8.70	ft

W=3Do+La

W=	11.70	ft

$d50=(0.02/Tw)*((Q/Do)^{4/3})$

d50=	0.01	ft
	0.15	in

PART IV – MAPS

LEGEND

SUBCATCHMENT LIMIT

SC-1 SUBCATCHMENT LABEL

TIME OF CONCENTRATION

AP1 DRAINAGE ANALYSIS POINT

MILFORD ROAD

ET LANE (PRIVATE)

AP1

AP2

SC-1

SC-2

MAP 133, PARCEL 1
N/F HILLTOP PROPERTIES, LLC
BK. 43962, PG. 36

N/F
HILLTOP FARMS CONDOMINIUM
BK. 35391, PG. 134

GARAGE

SHED

BARN

BIT. CONC.

EDGE OF PAVEMENT

12" CMP

RETAINING WALL

50' BVW BUFFER ZONE

100' BVW BUFFER ZONE

25' NO DISTURB

TOWN OF GRAFTON

TOWN OF NORTHBRIDGE

APPROX. ZONE LINE

OFFICE-LIGHT INDUSTRIAL

INDUSTRIAL 1

MAP 25, PARCEL 105
N/F HILLTOP PROPERTIES, LLC
BK. 48884, PG. 182
P.B. 882, PL. 99

HYDRAULIC SOIL CLASS BREAK USED FOR ANALYSIS AS SHOWN ON PLAN ENTITLED "HILLTOP PLAZA" 116 MILFORD ROAD IN GRAFTON, MASS, DATED FEBRUARY 2, 2009, REVISED APRIL 13, 2010, BY GUERRIERE & HALNON, INC.

ASE

Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning

P.O. Box 312, 104 Mendon Street
Uxbridge, Massachusetts 01569
P: 508-278-3897 F: 508-278-2289

500 East Washington Street
North Attleboro, Massachusetts 02760
P: 508-316-0452 F: 508-316-0963

PROJECT:
PROPOSED SELF-STORAGE FACILITY
100 MILFORD ROAD
SOUTH GRAFTON, MA 01560

OWNER/APPLICANT:
HILLTOP SELF-STORAGE
OF GRAFTON, LLC
100 MILFORD ROAD
SOUTH GRAFTON, MA 01560

REVISIONS

NO.	DATE	DESCRIPTION

DRAWN BY	JJS
CHECKED BY	PBH, SJO
DATE	FEBRUARY 4, 2015
PROJECT NO.	2014-316

GRAPHIC SCALE

(IN FEET)
1 inch = 80 Feet

SHEET TITLE

WATERSHED MAP
EXISTING CONDITIONS

DRAWING NO.

D1

PLAN NO. L-4502

LEGEND

SUBCATCHMENT LIMIT

SC-1 SUBCATCHMENT LABEL

TIME OF CONCENTRATION

AP1 DRAINAGE ANALYSIS POINT

MILFORD ROAD

(PRIVATE) LANE

AP1

AP2

SC-1

SC-2

SC-3

MAP 133, PARCEL 1
N/F HILLTOP PROPERTIES, LLC
BK. 43962, PG. 36

N/F
HILLTOP FARMS CONDOMINIUM
BK. 35391, PG. 134

MAP 133, PARCEL 1
N/F HILLTOP PROPERTIES, LLC
BK. 43962, PG. 36

MAP 28, PARCEL 105
N/F HILLTOP PROPERTIES, LLC
BK. 46884, PG. 168
P.B. 882, PL. 99

TOWN OF GRAFTON

TOWN OF NORTHBRIDGE

APPROX. OFFICE-LIGHT INDUSTRIAL ZONE LINE — INDUSTRIAL I

HYDRAULIC SOIL CLASS BREAK USED FOR ANALYSIS AS SHOWN ON PLAN ENTITLED "HILLTOP PLAZA" 116 MILFORD ROAD IN GRAFTON, MASS, DATED FEBRUARY 2, 2009, REVISED APRIL 13, 2010, BY GUERRIERE & HALNON, INC.

BUILDING SETBACK LINE

25' NO DISTURB ZONE

PROPOSED LEACH FIELD

GARAGE

BARN

STORMWATER BASIN

GRAVEL ACCESS ROAD

ASE

Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning

P.O. Box 312, 104 Meadon Street
Uxbridge, Massachusetts 01569
P: 508-278-3897 F: 508-278-2289

580 East Washington Street
North Attleboro, Massachusetts 02760
P: 508-316-0452 F: 508-316-0963

PROJECT:
PROPOSED SELF-STORAGE FACILITY
100 MILFORD ROAD
SOUTH GRAFTON, MA 01560

OWNER/APPLICANT:
HILLTOP SELF-STORAGE
OF GRAFTON, LLC
100 MILFORD ROAD
SOUTH GRAFTON, MA 01560

REVISIONS

NO.	DATE	DESCRIPTION

DRAWN BY	JJS
CHECKED BY	PBH, SJO
DATE	FEBRUARY 4, 2015
PROJECT NO.	2014-316

GRAPHIC SCALE

30 0 15 30 60

(IN FEET)
1 inch = 60 feet

SHEET TITLE

WATERSHED MAP
DEVELOPED CONDITIONS

DRAWING NO.

D2

PLAN NO. 1-4502

LEGEND

SUBCATCHMENT LIMIT

SC-1 SUBCATCHMENT LABEL

TIME OF CONCENTRATION

AP1 DRAINAGE ANALYSIS POINT

ET LANE (PRIVATE)

ROAD

MILFORD

AP1

AP2

SC-1

SC-2

SC-3

CB9

CB8

CB2

CB4

CB1

CB6

DCB5

DCB7

DCB3

BIT. CON.

GARAGE

TRANSFORMER

RECESSED LEACH FIELD

GRAVEL

BARN

STORMWATER BARN

EDGE OF PAVEMENT

BUILDING SETBACK LINE

GUARDRAIL

12" CMP

TOWN OF GRAFTON

TOWN OF NORTHBRIDGE

APPROX. ZONE LINE

OFFICE-LIGHT INDUSTRIAL

INDUSTRIAL 1

GRAVEL ACCESS ROAD

ASE

Andrews Survey & Engineering, Inc.
Land Surveying - Civil Engineering - Site Planning

P.O. Box 312, 104 Meadon Street
Uxbridge, Massachusetts 01569
P: 508-278-3897 F: 508-278-3289

500 East Washington Street
North Attleboro, Massachusetts 02760
P: 508-316-0452 F: 508-316-0963

PROJECT:
PROPOSED SELF-STORAGE FACILITY
100 MILFORD ROAD
SOUTH GRAFTON, MA 01560

OWNER/APPLICANT:
HILLTOP SELF-STORAGE
OF GRAFTON, LLC
100 MILFORD ROAD
SOUTH GRAFTON, MA 01560

REVISIONS

NO.	DATE	DESCRIPTION

DRAWN BY	JJS
CHECKED BY	PBH, SJO
DATE	FEBRUARY 4, 2015
PROJECT NO.	2014-316

GRAPHIC SCALE

(IN FEET)
1 inch = 50 Feet

SHEET TITLE

CATCH BASIN SUBCATCHMENT AREAS

DRAWING NO.

D3

PLAN NO. L-4502

P:\ACAD\2015 PROJECTS\2015-271\DWG\2014-316_DRAINAGE.DWG 02-05-15 4:19:43 PM - LAYOUT D3

APPENDIX

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

A. Introduction

Important: When filling out forms on the computer, use only the tab key to move your cursor - do not use the return key.

A Stormwater Report must be submitted with the Notice of Intent permit application to document compliance with the Stormwater Management Standards. The following checklist is NOT a substitute for the Stormwater Report (which should provide more substantive and detailed information) but is offered here as a tool to help the applicant organize their Stormwater Management documentation for their Report and for the reviewer to assess this information in a consistent format. As noted in the Checklist, the Stormwater Report must contain the engineering computations and supporting information set forth in Volume 3 of the Massachusetts Stormwater Handbook. The Stormwater Report must be prepared and certified by a Registered Professional Engineer (RPE) licensed in the Commonwealth.

The Stormwater Report must include:

- The Stormwater Checklist completed and stamped by a Registered Professional Engineer (see page 2) that certifies that the Stormwater Report contains all required submittals.[1] This Checklist is to be used as the cover for the completed Stormwater Report.
- Applicant/Project Name
- Project Address
- Name of Firm and Registered Professional Engineer that prepared the Report
- Long-Term Pollution Prevention Plan required by Standards 4-6
- Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan required by Standard 8[2]
- Operation and Maintenance Plan required by Standard 9

In addition to all plans and supporting information, the Stormwater Report must include a brief narrative describing stormwater management practices, including environmentally sensitive site design and LID techniques, along with a diagram depicting runoff through the proposed BMP treatment train. Plans are required to show existing and proposed conditions, identify all wetland resource areas, NRCS soil types, critical areas, Land Uses with Higher Potential Pollutant Loads (LUHPPL), and any areas on the site where infiltration rate is greater than 2.4 inches per hour. The Plans shall identify the drainage areas for both existing and proposed conditions at a scale that enables verification of supporting calculations.

As noted in the Checklist, the Stormwater Management Report shall document compliance with each of the Stormwater Management Standards as provided in the Massachusetts Stormwater Handbook. The soils evaluation and calculations shall be done using the methodologies set forth in Volume 3 of the Massachusetts Stormwater Handbook.

To ensure that the Stormwater Report is complete, applicants are required to fill in the Stormwater Report Checklist by checking the box to indicate that the specified information has been included in the Stormwater Report. If any of the information specified in the checklist has not been submitted, the applicant must provide an explanation. The completed Stormwater Report Checklist and Certification must be submitted with the Stormwater Report.

[1] The Stormwater Report may also include the Illicit Discharge Compliance Statement required by Standard 10. If not included in the Stormwater Report, the Illicit Discharge Compliance Statement must be submitted prior to the discharge of stormwater runoff to the post-construction best management practices.

[2] For some complex projects, it may not be possible to include the Construction Period Erosion and Sedimentation Control Plan in the Stormwater Report. In that event, the issuing authority has the discretion to issue an Order of Conditions that approves the project and includes a condition requiring the proponent to submit the Construction Period Erosion and Sedimentation Control Plan before commencing any land disturbance activity on the site.

Massachusetts Department of Environmental Protection
Bureau of Resource Protection - Wetlands Program

Checklist for Stormwater Report

B. Stormwater Checklist and Certification

The following checklist is intended to serve as a guide for applicants as to the elements that ordinarily need to be addressed in a complete Stormwater Report. The checklist is also intended to provide conservation commissions and other reviewing authorities with a summary of the components necessary for a comprehensive Stormwater Report that addresses the ten Stormwater Standards.

Note: Because stormwater requirements vary from project to project, it is possible that a complete Stormwater Report may not include information on some of the subjects specified in the Checklist. If it is determined that a specific item does not apply to the project under review, please note that the item is not applicable (N.A.) and provide the reasons for that determination.

A complete checklist must include the Certification set forth below signed by the Registered Professional Engineer who prepared the Stormwater Report.

Registered Professional Engineer's Certification

I have reviewed the Stormwater Report, including the soil evaluation, computations, Long-term Pollution Prevention Plan, the Construction Period Erosion and Sedimentation Control Plan (if included), the Long-term Post-Construction Operation and Maintenance Plan, the Illicit Discharge Compliance Statement (if included) and the plans showing the stormwater management system, and have determined that they have been prepared in accordance with the requirements of the Stormwater Management Standards as further elaborated by the Massachusetts Stormwater Handbook. I have also determined that the information presented in the Stormwater Checklist is accurate and that the information presented in the Stormwater Report accurately reflects conditions at the site as of the date of this permit application.

Registered Professional Engineer Block and Signature

Signature and Date

Checklist

Project Type: Is the application for new development, redevelopment, or a mix of new and redevelopment?

☒ New development

☐ Redevelopment

☐ Mix of New Development and Redevelopment

Checklist for Stormwater Report

Checklist (continued)

LID Measures: Stormwater Standards require LID measures to be considered. Document what environmentally sensitive design and LID Techniques were considered during the planning and design of the project:

- ☒ No disturbance to any Wetland Resource Areas
- ☐ Site Design Practices (e.g. clustered development, reduced frontage setbacks)
- ☐ Reduced Impervious Area (Redevelopment Only)
- ☐ Minimizing disturbance to existing trees and shrubs
- ☐ LID Site Design Credit Requested:
  - ☐ Credit 1
  - ☐ Credit 2
  - ☐ Credit 3
- ☐ Use of "country drainage" versus curb and gutter conveyance and pipe
- ☐ Bioretention Cells (includes Rain Gardens)
- ☐ Constructed Stormwater Wetlands (includes Gravel Wetlands designs)
- ☐ Treebox Filter
- ☐ Water Quality Swale
- ☐ Grass Channel
- ☐ Green Roof
- ☐ Other (describe): _____

Standard 1: No New Untreated Discharges

- ☒ No new untreated discharges
- ☒ Outlets have been designed so there is no erosion or scour to wetlands and waters of the Commonwealth
- ☒ Supporting calculations specified in Volume 3 of the Massachusetts Stormwater Handbook included.

Checklist for Stormwater Report

Checklist (continued)

Standard 2: Peak Rate Attenuation

☐ Standard 2 waiver requested because the project is located in land subject to coastal storm flowage and stormwater discharge is to a wetland subject to coastal flooding.

☐ Evaluation provided to determine whether off-site flooding increases during the 100-year 24-hour storm.

☒ Calculations provided to show that post-development peak discharge rates do not exceed pre-development rates for the 2-year and 10-year 24-hour storms. If evaluation shows that off-site flooding increases during the 100-year 24-hour storm, calculations are also provided to show that post-development peak discharge rates do not exceed pre-development rates for the 100-year 24-hour storm.

Standard 3: Recharge

☐ Soil Analysis provided.

☒ Required Recharge Volume calculation provided.

☐ Required Recharge volume reduced through use of the LID site Design Credits.

☒ Sizing the infiltration, BMPs is based on the following method: Check the method used.

☐ Static ☐ Simple Dynamic ☒ Dynamic Field[1]

☒ Runoff from all impervious areas at the site discharging to the infiltration BMP.

☐ Runoff from all impervious areas at the site is *not* discharging to the infiltration BMP and calculations are provided showing that the drainage area contributing runoff to the infiltration BMPs is sufficient to generate the required recharge volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume.

☐ Recharge BMPs have been sized to infiltrate the Required Recharge Volume *only* to the maximum extent practicable for the following reason:

- ☐ Site is comprised solely of C and D soils and/or bedrock at the land surface
- ☐ M.G.L. c. 21E sites pursuant to 310 CMR 40.0000
- ☐ Solid Waste Landfill pursuant to 310 CMR 19.000
- ☐ Project is otherwise subject to Stormwater Management Standards only to the maximum extent practicable.

☒ Calculations showing that the infiltration BMPs will drain in 72 hours are provided.

☐ Property includes a M.G.L. c. 21E site or a solid waste landfill and a mounding analysis is included.

[1] 80% TSS removal is required prior to discharge to infiltration BMP if Dynamic Field method is used.

Checklist for Stormwater Report

Checklist (continued)

Standard 3: Recharge (continued)

☒ The infiltration BMP is used to attenuate peak flows during storms greater than or equal to the 10-year 24-hour storm and separation to seasonal high groundwater is less than 4 feet and a mounding analysis is provided.

☐ Documentation is provided showing that infiltration BMPs do not adversely impact nearby wetland resource areas.

Standard 4: Water Quality

The Long-Term Pollution Prevention Plan typically includes the following:

- Good housekeeping practices;
- Provisions for storing materials and waste products inside or under cover;
- Vehicle washing controls;
- Requirements for routine inspections and maintenance of stormwater BMPs;
- Spill prevention and response plans;
- Provisions for maintenance of lawns, gardens, and other landscaped areas;
- Requirements for storage and use of fertilizers, herbicides, and pesticides;
- Pet waste management provisions;
- Provisions for operation and management of septic systems;
- Provisions for solid waste management;
- Snow disposal and plowing plans relative to Wetland Resource Areas;
- Winter Road Salt and/or Sand Use and Storage restrictions;
- Street sweeping schedules;
- Provisions for prevention of illicit discharges to the stormwater management system;
- Documentation that Stormwater BMPs are designed to provide for shutdown and containment in the event of a spill or discharges to or near critical areas or from LUHPPL;
- Training for staff or personnel involved with implementing Long-Term Pollution Prevention Plan;
- List of Emergency contacts for implementing Long-Term Pollution Prevention Plan.

☒ A Long-Term Pollution Prevention Plan is attached to Stormwater Report and is included as an attachment to the Wetlands Notice of Intent.

☐ Treatment BMPs subject to the 44% TSS removal pretreatment requirement and the one inch rule for calculating the water quality volume are included, and discharge:

- ☐ is within the Zone II or Interim Wellhead Protection Area
- ☐ is near or to other critical areas
- ☐ is within soils with a rapid infiltration rate (greater than 2.4 inches per hour)
- ☐ involves runoff from land uses with higher potential pollutant loads.

☐ The Required Water Quality Volume is reduced through use of the LID site Design Credits.

☒ Calculations documenting that the treatment train meets the 80% TSS removal requirement and, if applicable, the 44% TSS removal pretreatment requirement, are provided.

Checklist for Stormwater Report

Checklist (continued)

Standard 4: Water Quality (continued)

☒ The BMP is sized (and calculations provided) based on:

- ☒ The ½" or 1" Water Quality Volume or
- ☐ The equivalent flow rate associated with the Water Quality Volume and documentation is provided showing that the BMP treats the required water quality volume.

☐ The applicant proposes to use proprietary BMPs, and documentation supporting use of proprietary BMP and proposed TSS removal rate is provided. This documentation may be in the form of the propriety BMP checklist found in Volume 2, Chapter 4 of the Massachusetts Stormwater Handbook and submitting copies of the TARP Report, STEP Report, and/or other third party studies verifying performance of the proprietary BMPs.

☐ A TMDL exists that indicates a need to reduce pollutants other than TSS and documentation showing that the BMPs selected are consistent with the TMDL is provided.

Standard 5: Land Uses With Higher Potential Pollutant Loads (LUHPPLs)

☐ The NPDES Multi-Sector General Permit covers the land use and the Stormwater Pollution Prevention Plan (SWPPP) has been included with the Stormwater Report.

☒ The NPDES Multi-Sector General Permit covers the land use and the SWPPP **will** be submitted ***prior to*** the discharge of stormwater to the post-construction stormwater BMPs.

☐ The NPDES Multi-Sector General Permit does ***not*** cover the land use.

☐ LUHPPLs are located at the site and industry specific source control and pollution prevention measures have been proposed to reduce or eliminate the exposure of LUHPPLs to rain, snow, snow melt and runoff, and been included in the long term Pollution Prevention Plan.

☐ All exposure has been eliminated.

☐ All exposure has ***not*** been eliminated and all BMPs selected are on MassDEP LUHPPL list.

☐ The LUHPPL has the potential to generate runoff with moderate to higher concentrations of oil and grease (e.g. all parking lots with >1000 vehicle trips per day) and the treatment train includes an oil grit separator, a filtering bioretention area, a sand filter or equivalent.

Standard 6: Critical Areas

☐ The discharge is near or to a critical area and the treatment train includes only BMPs that MassDEP has approved for stormwater discharges to or near that particular class of critical area.

☐ Critical areas and BMPs are identified in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 7: Redevelopments and Other Projects Subject to the Standards only to the maximum extent practicable

☐ The project is subject to the Stormwater Management Standards only to the maximum Extent Practicable as a:

- ☐ Limited Project
- ☐ Small Residential Projects: 5-9 single family houses or 5-9 units in a multi-family development provided there is no discharge that may potentially affect a critical area.
- ☐ Small Residential Projects: 2-4 single family houses or 2-4 units in a multi-family development with a discharge to a critical area
- ☐ Marina and/or boatyard provided the hull painting, service and maintenance areas are protected from exposure to rain, snow, snow melt and runoff
- ☐ Bike Path and/or Foot Path
- ☐ Redevelopment Project
- ☐ Redevelopment portion of mix of new and redevelopment.

☐ Certain standards are not fully met (Standard No. 1, 8, 9, and 10 must always be fully met) and an explanation of why these standards are not met is contained in the Stormwater Report.

☐ The project involves redevelopment and a description of all measures that have been taken to improve existing conditions is provided in the Stormwater Report. The redevelopment checklist found in Volume 2 Chapter 3 of the Massachusetts Stormwater Handbook may be used to document that the proposed stormwater management system (a) complies with Standards 2, 3 and the pretreatment and structural BMP requirements of Standards 4-6 to the maximum extent practicable and (b) improves existing conditions.

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control

A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan must include the following information:

- Narrative;
- Construction Period Operation and Maintenance Plan;
- Names of Persons or Entity Responsible for Plan Compliance;
- Construction Period Pollution Prevention Measures;
- Erosion and Sedimentation Control Plan Drawings;
- Detail drawings and specifications for erosion control BMPs, including sizing calculations;
- Vegetation Planning;
- Site Development Plan;
- Construction Sequencing Plan;
- Sequencing of Erosion and Sedimentation Controls;
- Operation and Maintenance of Erosion and Sedimentation Controls;
- Inspection Schedule;
- Maintenance Schedule;
- Inspection and Maintenance Log Form.

☐ A Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan containing the information set forth above has been included in the Stormwater Report.

Checklist for Stormwater Report

Checklist (continued)

Standard 8: Construction Period Pollution Prevention and Erosion and Sedimentation Control (continued)

☐ The project is highly complex and information is included in the Stormwater Report that explains why it is not possible to submit the Construction Period Pollution Prevention and Erosion and Sedimentation Control Plan with the application. A Construction Period Pollution Prevention and Erosion and Sedimentation Control has ***not*** been included in the Stormwater Report but will be submitted ***before*** land disturbance begins.

☐ The project is ***not*** covered by a NPDES Construction General Permit.

☐ The project is covered by a NPDES Construction General Permit and a copy of the SWPPP is in the Stormwater Report.

☒ The project is covered by a NPDES Construction General Permit but no SWPPP been submitted. The SWPPP will be submitted BEFORE land disturbance begins.

Standard 9: Operation and Maintenance Plan

☒ The Post Construction Operation and Maintenance Plan is included in the Stormwater Report and includes the following information:

- ☒ Name of the stormwater management system owners;
- ☒ Party responsible for operation and maintenance;
- ☒ Schedule for implementation of routine and non-routine maintenance tasks;
- ☒ Plan showing the location of all stormwater BMPs maintenance access areas;
- ☐ Description and delineation of public safety features;
- ☒ Estimated operation and maintenance budget; and
- ☒ Operation and Maintenance Log Form.

☐ The responsible party is ***not*** the owner of the parcel where the BMP is located and the Stormwater Report includes the following submissions:

- ☐ A copy of the legal instrument (deed, homeowner's association, utility trust or other legal entity) that establishes the terms of and legal responsibility for the operation and maintenance of the project site stormwater BMPs;
- ☐ A plan and easement deed that allows site access for the legal entity to operate and maintain BMP functions.

Standard 10: Prohibition of Illicit Discharges

☒ The Long-Term Pollution Prevention Plan includes measures to prevent illicit discharges;

☒ An Illicit Discharge Compliance Statement is attached;

☐ NO Illicit Discharge Compliance Statement is attached but will be submitted ***prior to*** the discharge of any stormwater to post-construction BMPs.

MAP SCALE 1" = 500'

250 0 500 1000

FEET

METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0842E

FIRM

FLOOD INSURANCE RATE MAP

WORCESTER COUNTY, MASSACHUSETTS (ALL JURISDICTIONS)

PANEL 842 OF 1075

(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
GRAFTON, TOWN OF	250306	0842	E
NORTHBRIDGE, TOWN OF	250322	0842	E
UPTON, TOWN OF	250340	0842	E

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

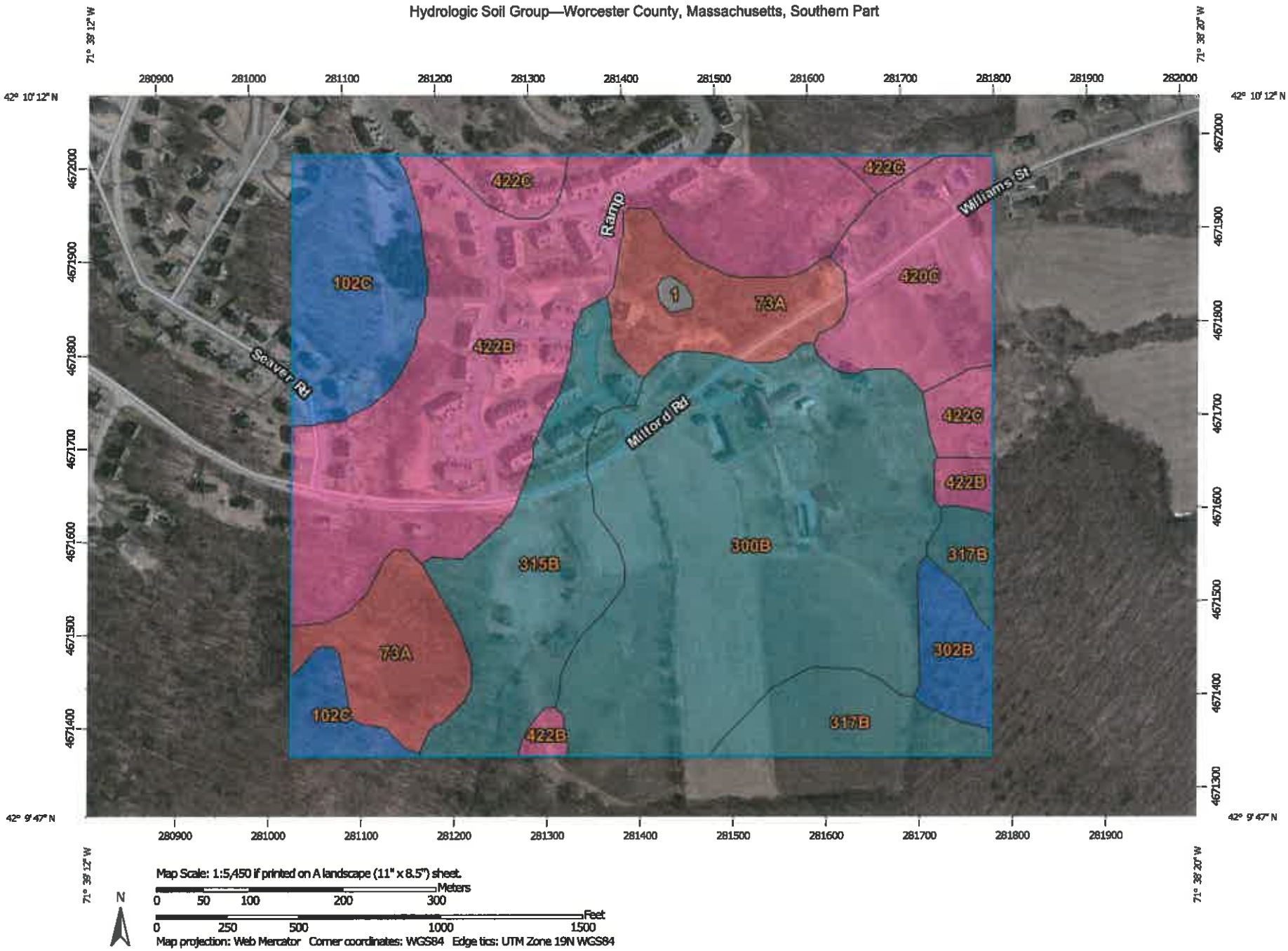
MAP NUMBER
25027C0842E

EFFECTIVE DATE
JULY 4, 2011

Federal Emergency Management Agency

This is an official copy of a portion of the above referenced flood map. It was extracted using F-MIT On-Line. This map does not reflect changes or amendments which may have been made subsequent to the date on the title block. For the latest product information about National Flood Insurance Program flood maps check the FEMA Flood Map Store at www.msc.fema.gov

Hydrologic Soil Group—Worcester County, Massachusetts, Southern Part



Map Scale: 1:5,450 if printed on A landscape (11" x 8.5") sheet.

Meters: 0 50 100 200 300

Feet: 0 250 500 1000 1500

Map projection: Web Mercator Corner coordinates: WGS84 Edge tics: UTM Zone 19N WGS84

MAP LEGEND

Area of Interest (AOI)
- Area of Interest (AOI)

Soils

Soil Rating Polygons
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Lines
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Soil Rating Points
- A
- A/D
- B
- B/D
- C
- C/D
- D
- Not rated or not available

Water Features
- Streams and Canals

Transportation
- Rails
- Interstate Highways
- US Routes
- Major Roads
- Local Roads

Background
- Aerial Photography

MAP INFORMATION

The soil surveys that comprise your AOI were mapped at 1:25,000.

Warning: Soil Map may not be valid at this scale.

Enlargement of maps beyond the scale of mapping can cause misunderstanding of the detail of mapping and accuracy of soil line placement. The maps do not show the small areas of contrasting soils that could have been shown at a more detailed scale.

Please rely on the bar scale on each map sheet for map measurements.

Source of Map: Natural Resources Conservation Service
Web Soil Survey URL: http://websoilsurvey.nrcs.usda.gov
Coordinate System: Web Mercator (EPSG:3857)

Maps from the Web Soil Survey are based on the Web Mercator projection, which preserves direction and shape but distorts distance and area. A projection that preserves area, such as the Albers equal-area conic projection, should be used if more accurate calculations of distance or area are required.

This product is generated from the USDA-NRCS certified data as of the version date(s) listed below.

Soil Survey Area: Worcester County, Massachusetts, Southern Part
Survey Area Data: Version 7, Sep 22, 2014

Soil map units are labeled (as space allows) for map scales 1:50,000 or larger.

Date(s) aerial images were photographed: Mar 30, 2011—May 1, 2011

The orthophoto or other base map on which the soil lines were compiled and digitized probably differs from the background imagery displayed on these maps. As a result, some minor shifting of map unit boundaries may be evident.

Hydrologic Soil Group

Hydrologic Soil Group— Summary by Map Unit — Worcester County, Massachusetts, Southern Part (MA615)				
Map unit symbol	Map unit name	Rating	Acres in AOI	Percent of AOI
1	Water		0.3	0.2%
73A	Whitman sandy loam, 0 to 3 percent slopes, extremely stony	D	11.8	9.8%
102C	Chatfield-Hollis-Rock outcrop complex, 3 to 15 percent slopes	B	11.0	9.2%
300B	Montauk fine sandy loam, 3 to 8 percent slopes	C	33.2	27.6%
302B	Montauk fine sandy loam, 3 to 8 percent slopes, extremely stony	B	2.7	2.3%
315B	Scituate fine sandy loam, 3 to 8 percent slopes	C	12.1	10.1%
317B	Scituate fine sandy loam, 3 to 8 percent slopes, extremely stony	C	6.1	5.1%
420C	Canton fine sandy loam, 8 to 15 percent slopes	A	8.8	7.3%
422B	Canton fine sandy loam, 3 to 8 percent slopes, extremely stony	A	30.5	25.4%
422C	Canton fine sandy loam, 8 to 15 percent slopes, extremely stony	A	3.8	3.1%
Totals for Area of Interest			**120.3**	**100.0%**

Description

Hydrologic soil groups are based on estimates of runoff potential. Soils are assigned to one of four groups according to the rate of water infiltration when the soils are not protected by vegetation, are thoroughly wet, and receive precipitation from long-duration storms.

The soils in the United States are assigned to four groups (A, B, C, and D) and three dual classes (A/D, B/D, and C/D). The groups are defined as follows:

Group A. Soils having a high infiltration rate (low runoff potential) when thoroughly wet. These consist mainly of deep, well drained to excessively drained sands or gravelly sands. These soils have a high rate of water transmission.

Group B. Soils having a moderate infiltration rate when thoroughly wet. These consist chiefly of moderately deep or deep, moderately well drained or well drained soils that have moderately fine texture to moderately coarse texture. These soils have a moderate rate of water transmission.

Group C. Soils having a slow infiltration rate when thoroughly wet. These consist chiefly of soils having a layer that impedes the downward movement of water or soils of moderately fine texture or fine texture. These soils have a slow rate of water transmission.

Group D. Soils having a very slow infiltration rate (high runoff potential) when thoroughly wet. These consist chiefly of clays that have a high shrink-swell potential, soils that have a high water table, soils that have a claypan or clay layer at or near the surface, and soils that are shallow over nearly impervious material. These soils have a very slow rate of water transmission.

If a soil is assigned to a dual hydrologic group (A/D, B/D, or C/D), the first letter is for drained areas and the second is for undrained areas. Only the soils that in their natural condition are in group D are assigned to dual classes.

Rating Options

Aggregation Method: Dominant Condition

Component Percent Cutoff: *None Specified*

Tie-break Rule: Higher

UPPER PARKING LOT TSS REMOVAL

A	B	C	D	E
BMP	**TSS Removal Rate**	**Starting TSS Load***	**Amount Removed (B x C)**	**Remaining Load (C - D)**
Street Sweeping	10.0%	100.0%	10.0%	90.0%
Deep sump CB's w/ hoods	25.0%	90.0%	22.5%	67.5%
Infiltration Basin w/ sediment forebay	80.0%	67.5%	54.0%	13.5%
		Total TSS Removal =	86.5%	

* Equals remaining load from previous BMP (E)

Massachusetts Stormwater Standards

Standard 10 - Illicit Discharge Compliance Statement

Site Address:	100 Milford Road South Grafton, MA
Owner:	Hilltop Properties, LLC
Applicant, if different:	Hilltop Self-Storage of Grafton, LLC
Plan Reference:	Proposed Self-Storage Facility Dated February 4, 2015
DEP File Number:	

As required by Standard 10 of the Massachusetts Stormwater Standards, I, the undersigned, being the Owner of the subject property do hereby certify that the stormwater system, as shown on the referenced plan, does not permit any illicit discharges to enter the stormwater management system. I also certify that the existing use of the property does not permit any illicit discharges.

Illicit discharges are discharges not associated with the following: stormwater; water from fire fighting; water line flushing or street washing; landscape watering and irrigation; uncontaminated groundwater; potable water; foundation or footing drains; air conditioning condensate; residential vehicle washing; residential non-detergent building cleaning water, de-chlorinated water from swimming pools; flows from riparian habitats or wetlands.

Further, I certify that the stormwater management system shown on the referenced plan will be maintained in accordance with the Operations and Maintenance Manual submitted with the Definitive Subdivision and approved by the Planning Board.

Signed: _____

Print: Rocco Addeo
Owner or Authorized Applicant

2/9/15
Date